

REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-9 and 21-32 are presently active in this case, Claims 1 and 7 amended, Claims 10-20 canceled and Claims 29-32 added by way of the present amendment.

In the outstanding Official Action, the restriction requirement issued June 1, 2005 was made final and Claims 10-20 were withdrawn from consideration; Claims 1, 2, and 4-7 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,493,855 to Sachdev; Claim 1 was rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,818,383 to Kawai; Claims 1 and 4-9 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Publication 2005/0051820 to Stojakovic; Claims 1 and 3-7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,316,167 to Angelopoulos in view of U.S. Patent No. 5,114,529 to Masuyama; and Claims 21-28 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Stojakovic and further in view of U.S. Patent Publication 2003/0022526.

Turning now to the merits, in order to expedite issuance of a patent in this case, Applicants have amended Claim 1 to clarify the patentable features of the present invention over the cited references. Specifically, Applicants' Claim 1, as amended, recites a method of preparing a structure on a substrate including preparing a film stack having a thin film, a hard mask formed on the thin film, and a layer of light-sensitive material formed on the hard mask. Also recited is forming a pattern in the layer of light-sensitive material, transferring the pattern to the hard mask to form a patterned hard mask and removing the layer of light-sensitive material. A surface layer of the patterned hard mask is treated in order to chemically alter the surface layer to a depth of at least 10 angstroms, and the pattern is transferred to the thin film using the patterned hard mask as an etch mask.

Thus, Applicants' Claim 1 has been amended to clarify that the surface layer of the hard mask is treated after the hard mask is patterned in order to chemically alter the surface layer to a depth of at least 10 angstroms, and further that the treated patterned hard mask is used as an etch mask. As described in Applicants' specification, treatment of the hard mask allows the hard mask to be more resilient to etch processes, thereby allowing a thinner hard mask to be used for a deeper etch depth.¹ Further, the improved resiliency of the hard mask also allows greater control of critical dimensions during the etch process.²

In contrast, the cited reference to Kawai discloses a semiconductor processing method wherein an antireflective film is exposed to an oxygen plasma. As seen in Figures 1A-1C, the antireflective film 5 is exposed to the plasma 2 prior to patterning of the antireflective film. Then, a resist is applied and patterned, and the antireflective film is patterned as shown in Figures 2A-2C. Thus, Kawai does not disclose treating a surface layer of the patterned hard mask as now required by Applicants' Claim 1. In this regard, Applicants note that Kawai's plasma exposure of the antireflective film prior to patterning of this film may cause the film to become more resilient, this resiliency can slow the subsequent etching of the antireflective film 5 in Kawai. Still further, even if Kawai alters the surface layer of the antireflective film, Kawai does not disclose chemically altering a surface layer of a patterned hard mask to a depth of at least 10 angstroms as also required by Claim 1. Thus, amended Claim 1 patentably defines over Kawai.

The cited reference to Sachdev et al. discloses a process for polymerized organosilicon films. As shown in Figures 1A-1D, an organic polymer layer 6 is applied to a substrate, and a plasma polymerized organosilicon film 7 is formed on top of the organic polymer layer 6, and a resist layer 8 is formed on top of the layer 6. As also seen in Figures 1D-1F, the films 6 and 7 are etched by using the resist layer 8 as a mask, and oxygen plasma

¹ See Applicants' specification at paragraph 28-30.

² See Applicants' specification at paragraph 31.

treatment of the layer 7 is performed after etching and just prior to deposition of metal. That is, Sachdev discloses treatment of the organosilicon film only after etching of the thin film has been performed. Thus, Sachdev does not disclose transferring the pattern to a thin film using a patterned hard mask as an etch mask. Further, Sachdev does not disclose chemically altering the hard mask to any particular depth. Therefore, Applicants' Claim 1 as amended patentably defines over Sachdev et al.

Stojakovic et al. discloses a process wherein an antireflective coating (ARC) layer 70 is formed on a film stack, and a resist layer 72 is formed on the ARC layer 70. As shown in Figures 5-7, the resist layer 72 is patterned and used to etch the ARC layer and underlying layers of the multilayer structure. However, both the resist layer and the ARC layer are stripped off as shown in Figure 8, prior to further etching of the multilayer structure. Thus, even if the ARC layer is treated during its removal using an oxygen plasma as the Office Action suggests, the treated layer is never used to transfer a pattern to a thin film as now required by Claim 1. Further, any treatment of the ARC layer in Stojakovic et al. is in advertent and therefore Stojakovic et al. does not disclose chemically altering a surface layer of the ARC layer to any particular depth as also required by Applicants' Claim 1.

Finally, the rejection of Claim 1 based on Angelopoulos et al. and Vyvoda et al. is based on the position that oxygen plasma ashing of a photoresist layer inherently alters the properties of an underlying hard mask layer. However, as noted above, any such altering of a hard mask layer is inadvertent and is therefore not to a depth of at least 10 angstroms as now required by Applicants' Claim 1. Indeed, none of the cited references disclose such a chemical altering of a surface layer.

For the reasons stated above, Applicants' independent Claim 1 patentably defines over the cited references. As Claims 2-9 and 21-32 depend from Claim 1, these claims also patentably define over the cited references. Nevertheless, Applicants note that Claims 29-32

have been added to vary the scope of protection provided by the claims, and to further clarify the patentable features of the present invention. Specifically, Claims 29-32 emphasize that an over treatment exposure process is performed on the hard mask after removal of the light sensitive material. Applicants submit that this limitation in combination with the limitations of Claim 1 are not shown by any of the cited references alone or in combination. Thus, Applicants' Claims 29-32 also patentably define over the cited references.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application and the present application is believed to be in condition for a formal allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



Steven P. Weihrouck
Registration No. 32,829

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 06/04)

Edwin D. Garlepp
Registration No. 45,330